DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]
This invention about the epitaxial wafer manufacturing installation, the susceptor structure, and the epitaxial wafer manufacturing method for forming an epitaxial layer in a wafer, In particular, it is related with the epitaxial wafer manufacturing installation, the susceptor structure, and the epitaxial wafer manufacturing method of the dopant concentration in the surface edge part of an epitaxial wafer which can control a rise.
[0002]
[Description of the Prior Art]
By growing up the crystal layer of silicon on the surface of a wafer, there is no crystal defect and the art of manufacturing the silicon wafer which has desired resistivity is known. The crystal layer of this silicon is a pole film which has a thickness of about several micrometers, for example when a diameter is a 0.75-mm-thick wafer [in 200 mm].
Generally it is called an epitaxial layer and the device which forms this epitaxial layer is called the epitaxial wafer manufacturing installation.
The thing of single wafer processing which mainly processes one silicon wafer at a time was used more often from the ease of thickness control, and the field of membrane quality by the epitaxial wafer manufacturing installation.
[0003]
As shown in drawing 1, in the epitaxial wafer manufacturing installation of this single wafer processing, the susceptor 4 (wafer buck) which supports only one wafer horizontally is usually formed in the processing chamber 2. In order to convey the wafer 12 on the susceptor 4, the lift mechanism for moving the wafer 12 up and down to the susceptor 4 is established. The lift mechanism has two or more lift pins 23 which penetrate the susceptor 4 and are prolonged.
You put the wafer 12 on the upper bed of these lift pins 23, and make it go up and down the wafer 12 by moving the lift pin 23 up and down relatively to the susceptor 4.
The thing [transferring the wafer 12 which was put on the hand of the arm for conveyance and has been carried in the chamber 2 by such lift mechanism on the susceptor 4, or delivering the wafer 12 to a hand from the susceptor 4 conversely] becomes possible.
[0004]

In order to grow up an epitaxial layer, it is necessary to heat the wafer 12 supported on the susceptor 4 to an elevated temperature. For this reason, the heat sources 8 and 9 of many halogen lamps (infrared lamp) etc. are arranged to the upper and lower sides of the processing chamber 2, and the susceptor 4 and the wafer 12 are heated.

[0005]

The susceptor 4 gives the tunic of the carbonization silicon SiC to the substrate of the carbon C, and when it heats the wafer 12, it plays a role of a soak board which keeps the temperature of the wafer 12 whole uniform. As shown in drawing 2, in order to store a silicon wafer, for example, it is somewhat larger than the wafer 12 on the upper surface of the susceptor 4, and the hollow called a wafer pocket about 1-2 mm deep is formed in it. The composition made into a tapered surface is used so that the internal surface of the wafer pocket 13 may contact only by the peripheral part of a wafer, and the device is given so that field contact of the internal surface of the wafer pocket 13 and the wafer 12 may be reduced as much as possible. The epitaxial layer which becomes the surface of the wafer 12 from a silicon thin film grows by accommodating the wafer 12 in this wafer pocket 13, and holding the susceptor 4 in the carrier gas which contains material gas with prescribed temperature. Material gas has referred to silicon source gas and dopant gas here.

[0006]

It is common that chlorosilicane system gas, such as trichlorosilane $SiHCl_3$ and dichlorosilane SiH_2Cl_2, is used for silicon source gas, and diborane (P type) and phosphine (N type) are used for dopant gas. These gases are introduced in a chamber with hydrogen H_2 which is carrier gas, and HCl generates them as a by-product with the silicon epitaxy by a heat CVD reaction in a wafer surface. Therefore, although silicon epitaxy advances in a wafer surface, Si-H-Cl system atmosphere is formed of the surroundings lump mainly depended on gas diffusion in a wafer rear face, and discharge of the dopant species from a wafer rear face takes place in Si-H-Cl system atmosphere.

[0007]

As a result, since the dopant concentration in the gaseous phase rises locally in a surroundings lump and the surface edge part of the wafer 12 to a wafer surface by diffusion in atmosphere including the dopant species it was [dopant species] full of the wafer pocket 13, The phenomenon in which the dopant concentration in an epitaxial layer rises in a wafer surface edge part is seen.

[0008]

In order to prevent atmosphere including the dopant species it was [dopant species] full of the wafer pocket 13 as mentioned above turning to a wafer surface, the invention indicated to JP,10-223545,A, As shown in drawing 16, the pore 50 penetrated at the rear face of the susceptor 4 is provided in the outermost periphery part of the wafer pocket 13. Thus, by forming the pore 50 penetrated at the rear face from the susceptor 4 surface in the outermost periphery part of the wafer pocket 13, Since the carrier gas containing the material gas which flows through the surface side of the susceptor 4 flows out under the susceptor 4 through the pore 50, atmosphere including the dopant species it was [dopant species] full of the wafer pocket 13 can be prevented from turning to the surface of the wafer 12.

[0009]

[Problem(s) to be Solved by the Invention]

In making gas flow out of the surface side of the susceptor 4 under the susceptor 4 like the invention indicated to JP,10-223545,A, Si amorphous, HCl, etc. which were decomposed with carrier gas in

material gas, such as strong reactant trichlorosilane $SiHCl_3$ and dichlorosilane SiH_2Cl_2, and the gaseous phase flow into the lower chamber 7b in large quantities.

[0010]

The lower chamber 7b includes the approach route of the rotary drive of the wafer 12, the lift mechanism, and the arm for conveyance, etc. as it understands, if drawing 1 is referred to, and it is dramatically difficult to clean up. Invasion of above material gas and decomposition products brings about increase of large maintenance time, and serves as an adverse factor of productivity. Increase of maintenance cost cannot be disregarded, either.

[0011]

Since it is heating according to the heat source 9 also from the lower chamber 7b side, the dirt of a chamber wall brings about aggravation of the unevenness of heating of the susceptor 4, or reproducibility, and causes variation in wafer quality.

[0012]

The place which it is made in order that the invention concerning this application may solve the above problems, and is made into the purpose, It is in providing the epitaxial wafer manufacturing installation and susceptor structure which can discharge atmosphere including the dopant species it was [dopant species] full of the wafer pocket without passing a lot of material gas under the susceptor from the surface side of a susceptor.

[0013]

Other purposes of the invention concerning this application are to provide the epitaxial wafer manufacturing installation and epitaxial wafer manufacturing method with which it is hard to flow through material gas under the susceptor from the surface side of a susceptor.

[0014]

[Means for Solving the Problem]

In order to attain the above-mentioned purpose, the 1st invention concerning this application, A way for gas supply which is a susceptor which has a concave wafer pocket which makes approximate circle plate shape and accommodates a wafer in the surface, and is penetrated from the side or a rear face of said susceptor to said wafer pocket, It is a susceptor which has a way for gas discharge penetrated at the side or a rear face of said susceptor from said wafer pocket.

[0015]

The 2nd invention concerning this application said way for gas supply, Making shape which supplies gas in said wafer pocket according to rotation of said susceptor, said way for gas discharge is a susceptor given in the 1st above-mentioned invention characterized by what shape which discharges gas in said wafer pocket according to rotation of said susceptor is made for.

[0016]

A chamber in which the 3rd invention concerning this application has a feed hopper and an outlet of gas, A concave wafer pocket which is arranged in said chamber and accommodates a wafer in the surface, A way for gas supply penetrated from the side or a rear face to said wafer pocket, It is an epitaxial wafer manufacturing installation provided with an approximate circle tabular susceptor which has a way for gas discharge penetrated at the side or the rear face from said wafer pocket, a support means which supports said susceptor, and said susceptor in said chamber and a heating method which heats a wafer.

[0017]

The 4th invention concerning this application is an epitaxial wafer manufacturing installation given in

the 3rd above-mentioned invention characterized by what it has for a gas supplying port which supplies carrier gas which contains material gas only up rather than said susceptor in said chamber.

[0018]

A susceptor which has a concave wafer pocket which the 5th invention concerning this application is arranged in a chamber and said chamber, and accommodates a wafer in the surface, A support means which supports said susceptor, and said susceptor in said chamber and a heating method which heats a wafer, A gas supplying port which is a ******** epitaxial wafer manufacturing installation and supplies carrier gas containing material gas above said susceptor in said chamber, It is an epitaxial wafer manufacturing installation provided with a heavy gas supplying port which supplies gas heavier than said carrier gas to a lower part of said susceptor in said chamber.

[0019]

A step which lays a wafer in said wafer pocket of a susceptor which has a concave wafer pocket which the 6th invention concerning this application is arranged in a chamber, and accommodates a wafer in the surface, A step which supplies gas to said wafer pocket from the lower part of said susceptor, It is an epitaxial wafer manufacturing method containing a step which discharges gas in said wafer pocket from the lower part of said susceptor, and said susceptor in said chamber and a step which heats said wafer.

[0020]

A step to which the 7th invention concerning this application lays a wafer on a susceptor arranged in a chamber, A step which supplies carrier gas containing material gas above said susceptor in said chamber, and supplies gas heavier than said carrier gas to a lower part of said susceptor, It is an epitaxial wafer manufacturing method containing said susceptor in said chamber, and a step which heats said wafer.

[0021]

[Embodiment of the Invention]

Hereafter, the embodiment of the invention concerning this application is described in detail based on drawing 1 - drawing 15, and drawing 17.

[0022]

[Explanation of the whole device]

Drawing 1 is vertical section which shows the outline structure of the epitaxial wafer manufacturing installation 1 concerning this invention. Since the outline structure of the epitaxial wafer manufacturing installation of this invention itself is almost the same as that of the epitaxial wafer manufacturing installation explained by conventional technology, it explains using the same drawing. In the figure, the structure of the chamber 2 is mainly indicated and the concrete graphic display is omitted about the rotary drive which the chamber 2 formed caudad.

[0023]

The chamber 2 sandwiches the cylindrical base ring 3 from the upper and lower sides by the disc-like upper window 5 and the lower saucer-like window 6, and an internal closed space forms a reactor. The quartz which has translucency so that light from a heat source may not be interrupted is used for the upper window 5 and the lower window 6. The reactor formed in the chamber 2 is divided roughly into the upper chamber 7a which is the space above the wafer 12, and the lower chamber 7b which is the space below the wafer 12.

[0024]

The upper and lower sides of the chamber 2 are equipped with the heat sources 8 and 9 which heat a

reactor. In this embodiment, two or more up-and-down heat sources 8 and 9 comprise a halogen lamp (infrared lamp) of the book, respectively.
[0025]
In the chamber 2, the susceptor 4 which supports the wafer 12 in the upper part is stored. If the susceptor 4 is seen from the upper part, it will carry out disc shape, the diameter is larger than the wafer 12, and the concave circular wafer pocket 13 by which the wafer 12 is stored is formed in the upper surface of the susceptor 4. The susceptor 4 gives the tunic of the carbonization silicon SiC to the substrate of the carbon C in this example, and when it heats the wafer 12, it plays a role of a soak board which keeps the temperature of the wafer 12 whole uniform. Therefore, the susceptor 4 has one several times the calorific capacity [one several times the thickness of this, and] of this rather than the wafer 12.
[0026]
Into a field parallel to the plate surface of the wafer 12, the susceptor 4 carries out rotational motion by making a vertical axis into a center of rotation between epitaxial layer growth treating operation so that a uniform epitaxial layer may be formed in the upper surface of the wafer 12. The center of the wafer pocket 13 provided in the susceptor 4 with the natural thing is in agreement with the center of rotation of the susceptor 4.
[0027]
Under the susceptor 4, the cylindrical or cylindrical suceptor support shaft 14 used as the axis of rotation of the susceptor 4 is arranged vertically, and equips the upper part of the suceptor support shaft 14 with the three susceptor arms 15 which support the susceptor 4 horizontally. The three susceptor arms 15 are radiately arranged so that the angle whose each is 120 degrees may be made, when it sees from the upper part, and the above heights provided at the tip of the susceptor arm 15 support the susceptor 4 in contact with the undersurface of the susceptor 4.
[0028]
The suceptor support shaft 14 is arranged at right angles to the position in which the axial center and disk center of the susceptor 4 correspond, and the susceptor 4 rotates it by rotation of the suceptor support shaft 14. The rotation to the suceptor support shaft 14 is given by an unillustrated rotary drive. The suceptor support shaft 14 and the susceptor arm 15 are formed from quartz of translucency so that light from the lower heat source 9 may not be interrupted.
[0029]
Drawing 2 is the figure which expressed the vertical section of the susceptor 4 typically. The wafer pocket 13 of the susceptor 4 consists of two or more steps and tapered surfaces so that it may explain below. For example, in the device which carries out epitaxial membrane formation processing of the wafer 300 mm in diameter, a disk member with a diameter of 350-400 mm and a thickness of 3-6 mm is used as the susceptor 4.
[0030]
The 1st step 30 that is a circular recess is formed in the position which tended toward a 20-40-mm center from the upper surface periphery of the susceptor 4. The 1st step 30 is the circular flat face established in the position which fell by 0.4-0.7 mm from the upper surface of the susceptor 4, and is the upper surface of the susceptor 4, and parallel, i.e., the level surface.
[0031]
The tapered surface 31 which has a loose inclination is established by making into the starting point the position which tended toward a 5-6-mm center from the periphery of the 1st step 30. The tapered surface

31 begins from the position which fell by about about 0.1 more mm rather than the 1st step 30, and makes the very loose funnel shape which has the inclination which falls by about 0.1 mm to the distance of 24-27 mm toward a center.

[0032]

The 2nd step 32 that is a circular recess is further formed toward the center from the tapered surface 31. From the tapered surface 31, the 2nd step 32 is the circular flat face established in the position which fell by about 0.3 mm, and is the upper surface of the susceptor 4, and parallel, i.e., the level surface.

[0033]

drawing 2 -- **** -- explanation -- convenience -- a top -- two -- a piece -- **** -- illustrating -- **** -- although -- the -- two -- a step -- 32 -- **** -- three -- a piece -- a through hole -- 22 -- providing -- having -- each -- a through hole -- 22 -- the upper part -- the upper part -- going -- an enlarged opening -- carrying out -- dished -- a hole -- 22 -- ' -- forming -- **** . The lift pin 23 for wafer support has inserted in the three through holes 22, respectively. The bore diameter of this through hole 22 is made larger than the diameter of the lift pin 23, and it is formed so that it may have a size which does not contact when the lift pin 23 moves up and down to the susceptor 4.

[0034]

The lift pin 23 becomes quartz, silicon Si, the carbonization silicon SiC, and quartz from what etc. gave the tunic of silicon Si or the carbonization silicon SiC. The lift pin 23 makes a pillar or cylindrical shape, and an upper bed part is equipped with the head 24 which has the tapered surface 24b on a lower periphery so that it may correspond to dished hole 22'. The tapered angle of the tapered surface 24b of this head 24 suits with the tapered angle of the tapered surface of dished hole 22'. As a result, the head 24 gives the seal outstanding to the wall of dished hole 22', and material gas is prevented from leaking through between the lift pin 23 and the walls of the through hole 22 by this.

[0035]

The upper part 24a of the head 24 has prevented generating of the crack on the rear face of a wafer by the lift pin 23 by making the conical shape in which a vertical angle makes an obtuse angle, and making very small the touch area at the time of supporting a wafer rear face. The head 24 engages with the wall of dished hole 22' of the susceptor 4, and the lift pin 23 hangs perpendicularly with prudence in the state where the lift pin 23 descended. At this time, the upper part 24a of the head 24 does not project from the upper surface of the 2nd step 32.

[0036]

As shown in drawing 1, the lift pin 23 hung to the susceptor 4, and the drum section has inserted in the through hole provided in the susceptor arm 15. Since the lift pin 23 is the independent unitary construction separated in the below-mentioned lift arm 16, when the susceptor 4 rotates, the lift pin 23 also rotates with the susceptor 4, but the lift arm 16 maintains the state where it stopped. Since the drum section of the lift pin 23 has inserted in the through hole provided in the susceptor arm 15, when the susceptor 4 rotates, the lift pin 23 can be prevented from inclining according to a centrifugal force.

[0037]

The cylindrical lift shaft 17 which has an inside diameter which can slide to the suceptor support shaft 14 is formed in the periphery of the suceptor support shaft 14. The upper bed of the lift shaft 17 is equipped with the three lift arms 16 radiately arranged so that each may make the angle which is 120 degrees, when it sees from the upper part. While the lift pin 23 descends and carrying out epitaxial membrane formation processing, the lift arm 16 and the lower end of the lift pin 23 maintain a

noncontact state, and do not apply load with the lift arm 16 excessive to the lift pin 23 at the time of rotation of the susceptor 4.

[0038]

In raising the wafer 12 from the susceptor 4, rotation of the susceptor 4 is stopped in the place where alignment of each lift pin 23 was carried out on the lift arm 16, and the lift arm 16 drops a rise or the suceptor support shaft 14. Thereby, in the lower end of the lift pin 23, in contact with the lift arm 16, the head 24 of the lift pin 23 goes up from the susceptor 4, and the wafer 12 is pushed up by the head 24 from a lower part, and goes up from the wafer pocket 13.

[0039]

As shown in drawing 1, on the periphery of the susceptor 4, the circular remaining-heat ring 19 which has the almost same thickness as the susceptor 4 is placed in a fixed position so that the susceptor 4 may be surrounded. The inner skin of the remaining-heat ring 19 takes only the interval which does not contact to the peripheral face of the susceptor 4, and is arranged, and it can be independently rotated by the susceptor 4 with the remaining-heat ring 19. The remaining-heat ring 19 gives the tunic of the carbonization silicon SiC to the substrate of the carbon C like the susceptor 4, and plays the role which prevents the rapid temperature change accompanying change of the calorific capacity in the peripheral part of the susceptor 4. Thus, by forming the remaining-heat ring 19 in the surroundings of the susceptor 4, from the central part, the susceptor 4 covers a peripheral part and is heated almost uniformly.

[0040]

As shown in drawing 1, the gas supplying port 10a and the gas exhaust 11 are established in the base ring 3. The carrier gas which contained material gas from the gas supplying port 10a on the left-hand side of [the] a figure is supplied, and it discharges from the right-hand side gas exhaust 11. From the gas supply unit which is not illustrated [which was provided in the chamber exterior], it lets the gas supplying port 10a pass, and material gas and carrier gas are supplied in the chamber 2.

[0041]

The gas supplying port 10a has an opening above the remaining-heat ring 19 in the inner skin of the base ring 3, and supplies hydrogen gas H_2 or hydrogen gas having contained material gas in the upper chamber 7a. As for material gas, the dopant gas of diborane (P type) or phosphine (N type) is mainly added by the silicon source gas of chlorosilicane systems, such as trichlorosilane $SiHCl_3$ and dichlorosilane SiH_2Cl_2. These gases are introduced in the upper chamber 7a with hydrogen gas H_2 which is carrier gas.

[0042]

Hydrogen gas H_2 is supplied in the lower chamber 7b through the lower part [gas supply unit / which is not illustrated / which the lower feed hopper 10b was formed independently / the gas supplying port 10a /, and was provided in the chamber exterior] feed hopper 10b. The lower feed hopper 10b has an opening below the remaining-heat ring 19 in the inner skin of the base ring 3, and supplies hydrogen gas H_2 in the lower chamber 7b.

Thus, the unnecessary reaction of the material gas in the lower chamber 7b can be prevented by supplying material gas only to the upper chamber 7a side.

[0043]

The gas exhaust 11 has two openings in the inner skin of the base ring 3 at **** [ring / 19 / remaining-

heat] and the bottom, puts together the gas from the upper chamber 7a and the lower chamber 7b, and discharges it out of the chamber 2.

[0044]

[A 1st embodiment]

Next, the structure of the susceptor in a 1st embodiment is explained in detail using drawing 3 - drawing 7.

[0045]

Drawing 3 is a perspective view by the side of the surface of the susceptor 4, and drawing 4 is a perspective view by the side of the rear face of the susceptor 4. The susceptor 4 is provided with four notches from the rear-face side of the susceptor 4 to [in a thickness direction] the mountain side of the susceptor 4 as shown in drawing 3 and drawing 4. Each notch has a rectangular opening in the peripheral face of the susceptor 4. The notches arranged to the center of the susceptor 4 at the symmetrical position make a pair, and four notches form the two gas stream necessary notches 25 and the two notches 26 for gas discharge. As shown in drawing 4, when it sees from the rear-face side of the susceptor 4, the gas stream necessary notch 25 and the notch 26 for gas discharge are the broad slots describing a loose curve. Although it is more desirable for the sectional shape of a slot to become narrow as it goes to the central part of the susceptor 4 from the periphery of the susceptor 4, it may be constant.

[0046]

Drawing 5 is a top view of the susceptor 4, and drawing 6 is a bottom view of the susceptor 4. As shown in drawing 5, the gas stream necessary notch 25 is formed so that it may whirl around toward a center in the direction of clockwise twining, and the notch 26 for gas discharge is formed so that it may whirl around toward the outside in the direction of clockwise twining.

[0047]

Drawing 7 is a B-B'sectional view of drawing 5. Since both the gas stream necessary notch 25 and the notch 26 for gas discharge have the same sectional shape, they explain only the sectional shape of the gas stream necessary notch 25 here. As shown in drawing 7, from the peripheral face of the susceptor 4 to the starting position of the tapered surface 31, the gas stream necessary notch 25 forms a slot toward a central direction, further, penetrates the susceptor 4 at the angle of 10-45 degrees aslant, and forms an opening in the tapered surface 31. It is good to penetrate the susceptor 4 at the angle of 20 degrees more preferably. As a result, the slot on which a curve is drawn toward a central direction from the peripheral face of the susceptor 4 is formed in the rear face of the susceptor 4, and it penetrates to the wafer pocket 13 in the place which came to the tapered surface 31.

[0048]

As the arrow a of drawing 3 shows, when it sees from the upper part, the susceptor 4 rotates counterclockwise. Then, as the arrow b shows, the carrier gas in the lower chamber 7b flows in the wafer pocket 13 from the gas stream necessary notch 25 of the susceptor 4, and as the arrow c shows, the gas in the wafer pocket 13 is discharged from the notch 26 for gas discharge. Thus, carrier gas flows through the gas stream necessary notch 25 from the rear-face side of the susceptor 4, and it circulates through the inside of the wafer pocket 13, and is discharged through the notch 26 for gas discharge at the rear-face side of the susceptor 4.

[0049]

Therefore, without passing a lot of material gas under the susceptor 4 from the surface side of the

susceptor 4 according to the susceptor 4 in a 1st embodiment, It becomes possible to discharge atmosphere including the dopant species diffused from the rear face of a wafer in process of epitaxial growth from the wafer pocket 13.

[0050]

Since the gas in the wafer pocket 13 is compulsorily discharged using rotation of the susceptor 4 at the time of epitaxial membrane formation, atmosphere including the dopant species it was [dopant species] full of the wafer pocket 13 can be more effectively prevented from turning to the surface of the wafer 12. Although it had composition which discharges the gas in the wafer pocket 13 compulsorily in this embodiment by forming the gas stream necessary notch 25 and the notch 26 for gas discharge as a curve-like slot, Even if it is a case where it is not a curve-like slot, the effect which discharges the gas in the wafer pocket 13 can be done so.

[0051]

According to the susceptor 4 in this embodiment, since the gas stream necessary notch 25 and the notch 26 for gas discharge are symmetrical shape, even if it is a case where the susceptor 4 is rotated in which direction of right reverse, the gas in the wafer pocket 13 can be discharged compulsorily. when it is made to rotate in the direction (clockwise rotation) opposite to the counterclockwise rotation shown in drawing 5, the gas stream necessary notch 25 functions as an object for gas discharge -- the notch 26 for gas discharge -- a gas stream -- it functions as necessary.

[0052]

In this embodiment, although the gas stream necessary notch 25 and the notch 26 for gas discharge showed the example penetrated from the rear-face side of the susceptor 4 to the tapered surface 31, both or one side may penetrate them to the 2nd step 32. Various change is possible for the number of the gas stream necessary notch 25 and the notch 26 for gas discharge by design, and each should just be at least one or more pieces.

[0053]

[A 2nd embodiment]

Other examples are shown in drawing 14 and drawing 15. The top view and drawing 15 as which drawing 14 regarded the susceptor 4 from the upper surface are a D-D'sectional view. Since the reverse form of a wafer is the same as that of a 1st embodiment, it explains with reference to drawing 4.

[0054]

The susceptor 4 is provided with four notches from the rear-face side of the susceptor 4 to [in a thickness direction] the mountain side of the susceptor 4 like a 1st embodiment, and each notch has a rectangular opening in the peripheral face of the susceptor 4. The notches arranged to the center of the susceptor 4 at the symmetrical position make a pair, and four notches form the two gas stream necessary notches 25 and the two notches 26 for gas discharge. As shown in drawing 4, when it sees from the rear-face side of the susceptor 4, the gas stream necessary notch 25 and the notch 26 for gas discharge are the broad slots describing a loose curve. Although it is more desirable for the sectional shape of a slot to become narrow as it goes to the central part of the susceptor 4 from the periphery of the susceptor 4, it may be constant.

[0055]

As shown in drawing 14, the gas stream necessary notch 25 is formed so that it may whirl around toward a center in the direction of clockwise twining, and the notch 26 for gas discharge is formed so that it may

whirl around toward the outside in the direction of clockwise twining.
[0056]
As shown in drawing 15, the susceptor 4 in this embodiment is provided with the scavenging-air step 51 formed in the peripheral part of the field 52 in which the wafer 12 is laid, and its field 52. The field 52 is a field about dented circularly according to the shape of the wafer 12 from the upper surface of the susceptor 4. The scavenging-air step 51 is a step which fell in the wafer rear-face side further rather than the field 52, and is the flat face established in the periphery of the field 52 in a circle. The wafer 12 shown with a two-dot chain line is laid in the field 52 formed inside the scavenging-air step 51, and a peripheral part is arranged so that the scavenging-air step 51 top may be covered. As a result, the circular space 53 is formed between the wafer 12 and the scavenging-air step 51. What is called a knurl process that forms the shallow striation of mesh state on the field 52 may be performed.
[0057]
Next, the sectional shape of the gas stream ON delivery volume notch 25 in this embodiment and the notch 26 for gas discharge is explained. Since both the gas stream necessary notch 25 and the notch 26 for gas discharge have the same sectional shape, they explain only the sectional shape of the gas stream ON delivery volume notch 25 here. As shown in drawing 15, from the peripheral face of the susceptor 4 to the starting position of the scavenging-air step 51, the gas stream necessary notch 25 forms a slot toward a central direction, further, penetrates the susceptor 4 at the angle of 10-45 degrees aslant, and forms an opening in the scavenging-air step 51. It is good to penetrate the susceptor 4 at the angle of 20 degrees more preferably.
[0058]
As the arrow a of drawing 14 shows, when it sees from the upper part, the susceptor 4 rotates counterclockwise. Then, as the arrow b shows, the carrier gas in the lower chamber 7b of the susceptor 4 flows into the scavenging-air step 51 from the gas stream necessary notch 25, and as the arrow c shows, it is discharged from the notch 26 for gas discharge. Thus, carrier gas flows through the gas stream necessary notch 25 from the rear-face side of the susceptor 4, and it circulates through the inside of the circular space 53, and is discharged through the notch 26 for gas discharge at the rear-face side of the susceptor 4.
[0059]
Therefore, according to the susceptor 4 in a 2nd embodiment, it becomes possible to discharge atmosphere including the dopant species it was [dopant species] full of the wafer pocket, without passing a lot of material gas under the susceptor 4 from the surface side of the susceptor 4.
[0060]
[A 3rd embodiment]
Next, the structure of the susceptor in a 3rd embodiment is explained in detail using drawing 8 - drawing 12.
[0061]
Drawing 8 is a perspective view by the side of the surface of the susceptor 4, and drawing 9 is a perspective view by the side of the rear face of the susceptor 4. The susceptor 4 is provided with three notches from the rear-face side of the susceptor 4 to [in a thickness direction] the mountain side of the susceptor 4 as shown in drawing 8 and drawing 9. Each notch is the gas stream necessary notch 27 which has a rectangular opening in the peripheral face of the susceptor 4. As shown in drawing 9, when

it sees from the rear-face side of the susceptor 4, the gas stream necessary notch 27 is a broad slot describing a loose curve. Although it is more desirable for the sectional shape of a slot to become narrow as it goes to the central part of the susceptor 4 from the periphery of the susceptor 4, it may be constant.

[0062]

Drawing 10 is a top view of the susceptor 4, and drawing 11 is a bottom view of the susceptor 4. Since the susceptor 4 rotates clockwise as the arrow a shows as shown in drawing 10, the gas stream necessary notch 27 is formed so that it may whirl around toward a center in the direction of counterclockwise twining. Each gas stream necessary notch 27 is formed in the position which makes the angle of 120 degrees mutually to the center of the susceptor 4 and which was deduced and made like at equal intervals.

[0063]

Drawing 12 (a) is an A-A'sectional view of drawing 10. As shown in drawing 12 (a), from the peripheral face of the susceptor 4 to the starting position of the tapered surface 31, the gas stream necessary notch 27 forms a slot toward a central direction, further, penetrates the susceptor 4 at the angle of 10-45 degrees aslant, and forms an opening in the tapered surface 31. It is good to penetrate the susceptor 4 at the angle of 20 degrees more preferably. As a result, the slot on which a curve is drawn toward a central direction from the peripheral face of the susceptor 4 is formed in the rear face of the susceptor 4, and it penetrates to the wafer pocket 13 in the place which came to the tapered surface 31.

[0064]

As shown in drawing 10, the susceptor 4 in this embodiment provides in the susceptor center-section neighborhood, i.e., the flat face of the 2nd step 32, the opening 28 for gas discharge which penetrates the susceptor 4 from the surface side to the rear-face side. Drawing 12 (b) is a C-C'sectional view of drawing 10. The opening 28 for gas discharge has an opening on the upper surface of the 2nd step 32 of the wafer pocket 13, penetrates the susceptor 4 at the angle of 10-45 degrees aslant, and forms an opening in the rear face of the susceptor 4 again. It is good to penetrate the susceptor 4 at the angle of 20 degrees more preferably. In drawing 10, although the opening 28 for gas discharge constitutes sectional shape in the quadrangle, the necessity for square may not necessarily have it and they may be a round shape and a triangle.

[0065]

As the arrow a of drawing 8 shows, when it sees from the upper part, the susceptor 4 rotates clockwise. Then, as the arrow b shows, the carrier gas in the lower chamber 7b of the susceptor 4 flows in the wafer pocket 13 from the gas stream necessary notch 27, and as the arrow c shows, the gas in the wafer pocket 13 is discharged from the opening 28 for gas discharge. Thus, carrier gas flows through the gas stream necessary notch 27 from the rear-face side of the susceptor 4, and it circulates through the inside of the wafer pocket 13, and is discharged through the opening 28 for gas discharge at the rear-face side of the susceptor 4.

[0066]

Therefore, according to the susceptor 4 in a 3rd embodiment, it becomes possible to discharge atmosphere including the dopant species it was [dopant species] full of the wafer pocket 13, without passing a lot of material gas under the susceptor 4 from the surface side of the susceptor 4.

[0067]

Since the gas in the wafer pocket 13 is compulsorily discharged using rotation of the susceptor 4 at the

time of epitaxial membrane formation, atmosphere including the dopant species it was [dopant species] full of the wafer pocket 13 can be more effectively prevented from turning to the surface of the wafer 12.

[0068]

Although the gas stream necessary notch 27 showed the example penetrated from the rear-face side of the susceptor 4 to the tapered surface 31 in this embodiment, it may penetrate to the 2nd step 32. Various change is possible for the number of the gas stream necessary notch 27 by design, and it should just be one or more pieces.

[0069]

As shown in the 1st - a 3rd embodiment, the shape in particular of the wafer pocket 13 does not need to be the composition which combined the step and the tapered surface, They may be the composition which the shallow striation of the mesh state of a tapered surface or what is called a knurl is formed, and only a step makes carry out contact support of the wafer with much heights, and the composition that the surface roughness of the silicon carbide covered on the surface uses a thing coarse farther than a wafer rear face. Anyway, the invention in this application is applicable, incorporates gas from the side or the rear face of the susceptor 4 in the wafer pocket 13, and attains to all the composition again discharged from the side or the rear face of the susceptor 4.

[0070]

[A 4th embodiment]

Next, the structure of the susceptor in a 4th embodiment is explained in detail using drawing 17. Since the entire configuration of the susceptor in this embodiment is almost the same as that of the susceptor in a 3rd embodiment shown in drawing 8, concrete explanation is omitted by attaching identical codes about identical parts.

[0071]

Drawing 17 is a perspective view by the side of the surface of the susceptor 4. Especially the susceptor 4 in this embodiment has the feature at the point which gas ** carried out and was provided with the slot 20, as the thick line of drawing 17 shows. Gas ** carries out, and the slot 20 is a circular shallow slot formed in the tapered surface 31, and it is formed so that the opening by the side of the wafer pocket 13 of each gas stream necessary notch 27 may be connected.

[0072]

Gas ** may make it details more, 3.0 mm in flute width and about 1.5 mm in channel depth may be sufficient as the slot 20, and, of course, the flute width may be not less than 1.5 mm in channel depth in not less than 3.0 mm. As for a flute width, from the purpose of raising exhaust efficiency, it is [a channel depth] desirable that it is 0.5 mm or more at 1.0 mm or more.

[0073]

Thus, by circular gas ** which connects the opening by the side of the wafer pocket 13 of each gas stream necessary notch 27 carrying out, and forming the slot 20 in the tapered surface 31, the exhaust efficiency of the portion where gas ** carries out and which has the slot 20 can be raised, or exhaust efficiency can be equalized by the circumferencial direction of a wafer.

[0074]

The thing which gas ** in this embodiment carries out, and connect the wafer pocket side opening of the gas stream necessary notch [in / for the slot 20 / a 1st embodiment of the above] 25 and the notch 26 for gas discharge and which is formed in a circle is also possible. Also in this case, the exhaust

efficiency of a portion with a slot can be raised, or exhaust efficiency can be equalized by the circumferencial direction of a wafer.

[0075]

Next, operation of the whole epitaxial wafer manufacturing installation of the invention in this application is explained using drawing 1. In this explanation of operation, explanation of mechanical operation of a rising and falling mechanism or a rotary drive is omitted, and explains only the relation of operation between a susceptor and a lift pin, and a wafer, and those physical relationship.

[0076]

First, the heat sources 8 and 9 of a vertical section are operated, and the susceptor 4 in the processing chamber 2 is heated to a temperature suitable for conveyance of a wafer. While about 800 ** is preferred and detects the temperature of the susceptor 4 in the chamber 2 by a thermostat sensor etc. as a wafer conveyance temperature, it controls to maintain the above-mentioned temperature requirement. Simultaneously, carrier gas is slushed from the gas supplying port 10a and the lower feed hopper 10b, and it is filled up with the inside of the upper chamber 7a and the lower chamber 7b with carrier gas. The chamber 2 has the gas exhaust 11 in the opposite hand of the gas supplying port 10a, and carrier gas always flows toward the gas exhaust 11 from the gas supplying port 10a and the lower feed hopper 10b. It is usually supplied into the chamber 2 in the state of ordinary temperature (room temperature), using hydrogen H_2 generally as carrier gas in many cases.

[0077]

Next, if the inside of the chamber 2 is fully heated and it fills up with carrier gas, the wafer 12 will be shortly carried in in the chamber 2. Slice machining of the wafer 12 is carried out from an ingot, and it is making disc-like [thin] through the polishing process etc. As an example, there is a thing (300 mm in diameter and about 0.7-0.75 mm in thickness). This wafer 12 is carried after the hand made from quartz, and a hand is put in in the chamber 2. The wafer 12 is transferred on the lift pin 23 which went up, and by dropping the lift pin 23 slowly, the wafer 12 fits into the wafer pocket 13 of the susceptor 4, and it will be in the state where a position gap of a longitudinal direction does not occur.

[0078]

The heat sources 8 and 9 of a vertical section are operated, and wafer surface temperature is raised to a temperature (1000-1200 **) suitable for epitaxial growth. By the instructions from an unillustrated control section, the motor for rotation is driven and the susceptor 4 is rotated. If rotation of the susceptor 4 is stabilized, material gas will be mixed to carrier gas and material gas will be supplied in the upper chamber 7a through the gas supplying port 10a. As for material gas, the dopant gas of diborane (P type) or phosphine (N type) is mainly added by the silicon source gas of chlorosilicane systems, such as trichlorosilane $SiHCl_3$ and dichlorosilane SiH_2Cl_2.

[0079]

The carrier gas containing material gas flows through the surface of the wafer 12, and an epitaxial layer begins to grow up to be a wafer surface. Since the wafer 12 is rotating in the level surface in the state where it was accommodated in the susceptor 4, the epitaxial layer which has almost uniform thickness grows up to be the surface of the wafer 12. At this time, HCl generates as a by-product with the silicon epitaxy by a heat CVD reaction in a wafer surface.

[0080]

According to the conventional device, silicon epitaxy advances in a wafer surface, but. Since Si-H-Cl

system atmosphere stops in the wafer pocket 13 by the surroundings lump mainly depended on gas diffusion in a wafer rear face, discharge of the dopant species from a wafer rear face takes place in Si-H-Cl system atmosphere.

[0081]

According to the susceptor 4 of this application explained in the 1st - a 4th embodiment as above-mentioned. After inhaling the carrier gas (hydrogen gas H_2 which does not contain material gas) in the lower chamber 7b from the side or the rear face of the susceptor 4 and circulating the inside of the wafer pocket 13 using the rotation at the time of the membrane formation processing to a wafer surface, it discharges from the side or the rear face of the susceptor 4. Then, it is discharged out of a chamber from the opening of the gas exhaust 11 bottom. Therefore, Si-H-Cl system atmosphere can be prevented from stopping in the wafer pocket 13, and the influence of discharge of the dopant species from a wafer rear face can be inhibited.

[0082]

If the epitaxial layer of desired thickness grows, supply of material gas will be suspended, the heat sources 8 and 9 will be controlled, and the inside of the chamber 2 will be lowered to wafer conveyance temperature. And the processed wafer 12 is taken out out of the chamber 2. The taking out should just follow a procedure contrary to carrying in.

[0083]

Next, the modification of the epitaxial wafer manufacturing installation in this application is explained. Drawing 13 is vertical section which shows the outline structure of the epitaxial wafer manufacturing installation 40. Since the outline structure of this epitaxial wafer manufacturing installation 40 very thing is almost the same as that of the epitaxial wafer manufacturing installation 1 explained using drawing 1, about a portion, a same sign is attached similarly and detailed explanation is omitted.

[0084]

The epitaxial wafer manufacturing installation 40 has connected the heavy gas supply means 41 and the carrier gas feeding means 42 with the heavy gas supplying port 45 formed in the base ring 3. The heavy gas source 44 is connected to the heavy gas supply means 41 via the flow control means 43, and the heavy gas supplied from the heavy gas source 44 is adjusted in the desired amount of supply by the flow control means 43. It is mixed with the carrier gas supplied from the carrier gas feeding means 42, and the heavy gas supplied from the heavy gas supply means 41 is supplied to the lower chamber 7b from the heavy gas supplying port 45. The amount of supply of the gas supplied from the gas supplied from the gas supplying port 10a and the heavy gas supplying port 45 is controlled by an unillustrated process controller.

[0085]

The heavy gas supplying port 45 supplies heavy gas only to the lower chamber 7b from the chamber 2 exterior, without crossing the gas supplying port 10a. As heavy gas, argon gas can be used, for example. It is required to be heavier than the carrier gas supplied to the upper chamber 7a fundamentally. As the heavy gas source 44, piping from an argon gas tank or an argon gas refinery plant can be used, and a massflow controller can be used as the flow control means 43.

[0086]

It is filled with heavy gas, such as argon gas supplied from the heavy gas supplying port 45, in the lower chamber 7b of the chamber 2. Since heavy gas is heavier than the carrier gas supplied to the upper

chamber 7a, material gas can be prevented from flowing in with carrier gas from the upper chamber 7a by filling the inside of the lower chamber 7b with heavy gas. As a result, atmosphere including the dopant species it was [dopant species] full of the wafer pocket can be discharged, without passing a lot of material gas from the surface side of the susceptor 4 to the lower part side of the susceptor 4. In drawing 13, although the heavy gas supplying port 45 is illustrated about the case where the mixed gas of carrier gas and heavy gas is supplied, a carrier gas feed hopper and a heavy gas supplying port may be provided independently.

[0087]

[Effect of the Invention]

According to the susceptor structure of this application, it becomes possible to discharge atmosphere including the dopant species it was [dopant species] full of the wafer pocket, without passing a lot of material gas under the susceptor from the surface side of a susceptor.

[0088]

According to the susceptor structure of this application, since the gas in a wafer pocket is compulsorily discharged using rotation of the susceptor at the time of epitaxial membrane formation, atmosphere including the dopant species it was [dopant species] full of the wafer pocket can be more effectively prevented from turning on the surface of a wafer.

[0089]

Even if it is a case where a susceptor is rotated in which direction of right reverse by forming a gas stream necessary notch and the notch for gas discharge in symmetrical shape, the gas in a wafer pocket can be discharged compulsorily.

[0090]

According to the epitaxial wafer manufacturing installation of this application, by supplying gas heavier than the carrier gas supplied to an upper chamber to a lower chamber, the inside of a lower chamber is filled with heavy gas, and material gas can be prevented from flowing in with carrier gas from an upper chamber. As a result, atmosphere including the dopant species it was [dopant species] full of the wafer pocket can be discharged, without passing a lot of material gas from the surface side of a susceptor to the lower part side of a susceptor.

[Brief Description of the Drawings]

[Drawing 1]It is drawing of longitudinal section showing the outline of the epitaxial wafer manufacturing installation of this application.

[Drawing 2]It is drawing of longitudinal section showing the outline of a susceptor.

[Drawing 3]It is a perspective view by the side of the surface of the susceptor in a 1st embodiment.

[Drawing 4]It is a perspective view by the side of the rear face of the susceptor in a 1st embodiment.

[Drawing 5]It is a top view of the susceptor in a 1st embodiment.

[Drawing 6]It is a bottom view of the susceptor in a 1st embodiment.

[Drawing 7]It is a B-B'sectional view of the susceptor shown in drawing 5.

[Drawing 8]It is a perspective view by the side of the surface of the susceptor in a 3rd embodiment.

[Drawing 9]It is a perspective view by the side of the rear face of the susceptor in a 3rd embodiment.

[Drawing 10]It is a top view of the susceptor in a 3rd embodiment.

[Drawing 11]It is a bottom view of the susceptor in a 3rd embodiment.

[Drawing 12](-- a --) -- drawing 10 -- being shown -- a susceptor -- A-A -- ' -- a sectional view -- (-- b --)

-- drawing 10 -- being shown -- a susceptor -- C-C -- ' -- a sectional view -- it is .
[Drawing 13]It is drawing of longitudinal section showing other examples of the epitaxial wafer manufacturing installation of this application.
[Drawing 14]It is a top view of the susceptor in a 2nd embodiment.
[Drawing 15]It is a D-D'sectional view of the susceptor shown in drawing 14.
[Drawing 16]It is drawing of longitudinal section showing the outline of the susceptor of conventional technology.
[Drawing 17]It is a perspective view by the side of the surface of the susceptor in a 4th embodiment.
[Description of Notations]
1 -- Epitaxial wafer manufacturing installation
2 -- Chamber
3 -- Base ring
4 -- Susceptor
5 -- Upper window
6 -- Lower window
7a -- Upper chamber 7b -- Lower chamber
8 -- Heat source
9 -- Heat source
10a -- Gas supplying port 10b -- Lower feed hopper
11 -- Gas exhaust
12 -- Wafer
13 -- Wafer pocket
14 -- Suceptor support shaft
15 -- Susceptor arm
16 -- Lift arm
17 -- Lift shaft
19 -- Remaining-heat ring
20 -- Gas ** carries out and it is a slot.
22 -- Through hole 22' -- Dished hole
23 -- Lift pin
24 -- Head 24a -- Upper part 24b -- Tapered surface
25 -- Gas stream necessary notch
26 -- Notch for gas discharge
27 -- Gas stream necessary notch
28 -- Opening for gas discharge
30 -- The 1st step
31 -- Tapered surface
32 -- The 2nd step
40 -- Epitaxial wafer manufacturing installation
41 -- Heavy gas supply means
42 -- Carrier gas feeding means
43 -- Flow control means

44 -- Heavy gas source
45 -- Heavy gas supplying port
50 -- Pore
51 -- Scavenging-air step
52 -- Field
53 -- Circular space.

[Translation done.]